

5.0 Allocation Analysis

TMDLs are comprised of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. TMDLs can be expressed in terms of mass per time or by other appropriate measures. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \text{Summation of WLAs} + \text{Summation of LAs} + \text{MOS}$$

In order to develop aluminum, iron, manganese, selenium, pH, and fecal coliform bacteria TMDLs for each of the waterbodies in the Guyandotte watershed listed on the West Virginia Section 303(d) list, the following approach was taken:

- Define TMDL endpoints
- Simulate baseline conditions
- Assess source loading alternatives
- Determine the TMDL and source allocations

5.1 TMDL Endpoints

TMDL endpoints represent the in-stream water quality targets used in quantifying TMDLs and their individual components. Different TMDL endpoints are necessary for dissolved aluminum, total iron, manganese, pH, selenium, and fecal coliform bacteria. West Virginia's numeric water quality criteria for the subject pollutants (identified in Section 2) and an explicit margin of safety (MOS) were used to identify endpoints for TMDL development.

5.1.1 Dissolved Aluminum, Total Iron, and Manganese

The TMDL endpoints for dissolved aluminum were selected as selected as 712.5 ug/L (based on the 750 ug/L acute criteria for aquatic life minus a 5 percent MOS) and 82.7 ug/L (based on the 87 ug/L chronic criteria for aquatic life minus a 5 percent MOS). The endpoint for total iron was selected as 1.425 mg/L (based on the 1.5 mg/L criteria for aquatic life minus a 5 percent MOS). The endpoint for manganese was selected as 0.95 mg/L (based on the 1.0 mg/L criteria for human health minus a 5 percent MOS).

Components of the TMDLs for aluminum, iron, and manganese are presented in terms of mass per time for nonpoint sources and mass per time and mass per volume for point sources in this report.

5.1.2 Fecal Coliform Bacteria

The endpoint for fecal coliform bacteria was selected as the instantaneous endpoint of 380 counts/100mL based on the 400 counts/100mL criterion for human health minus a 5 percent MOS and the geometric mean endpoint of 190 counts/100mL based on the 200 counts/100mL

geometric mean criterion minus an approximate 5 percent MOS. The instantaneous criterion is more stringent and more difficult to obtain, however, both criteria are satisfied in this TMDL.

5.1.3 Selenium

In meeting the West Virginia water quality criteria for selenium at the end of pipe for the surface mining point sources, there will be no excessive contribution of selenium to the streams in the upper Mud River watershed at the low flow 7Q10 conditions where the assimilative capacity is lowest. This results in the inclusion of an implicit margin of safety. Determination of an explicit margin of safety is not necessary for these particular TMDLs because in presenting the allocations as a concentration at the water quality criteria for selenium the sources will comply with the water quality standards and there will be no uncertainty involved.

5.1.4 pH

The water quality criteria for pH requires it to be above six and below nine (inclusive). In the case of acid mine drainage, pH, is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near neutral pH (~seven) but containing elevated concentrations of dissolved ferrous (Fe^{2+}) ions can become acidic after oxidation and precipitation of the iron (PADEP, 2000). Therefore, a more practical approach to meeting the water standards of pH is to use the concentration of metal ions as a surrogate for pH. Through reducing in-stream metals, namely iron, to meet water quality criteria (or TMDL endpoints), it is assumed that the pH will result in meeting the WQS. This assumption is based on the application of MINTEQA2, a geochemical equilibrium speciation model, to aqueous systems representative of waterbodies in the Guyandotte watershed. By inputting into the model the total concentrations of metals, a pH value can be predicted. Refer to Section 4.5 for a detailed description of the modeling.

5.1.5 Margin of Safety

An implicit MOS was included in TMDL development through application of a dynamic model for simulating daily loading over a wide range of hydrologic and environmental conditions, and through the use of conservative assumptions in model calibration and scenario development. In addition to this implicit margin of safety, a 5 percent explicit MOS was used to account for the differences between modeled and monitored data. Long-term water quality monitoring data were used for model calibration. While these data represented actual conditions, they were not continuous time series and may not have captured the full range of in-stream conditions that occurred during the simulation period. The explicit 5 percent MOS also accounts for those cases where monitoring data may not have captured the full range of in-stream conditions.

5.2 Baseline Conditions

The calibrated model provided the basis for performing the allocation analysis. The first step in this analysis involved simulation of baseline conditions. Baseline conditions represent existing nonpoint source loading conditions, unpermitted source loading conditions, and permitted point source discharge conditions. The baseline conditions allow for an evaluation of in-stream water quality under the “worst currently allowable” scenario.

The MDAS model was run for baseline conditions using hourly precipitation data for a representative 6-year time period. The precipitation experienced over this period was applied to the landuses and pollutant sources as they existed at the time of this TMDL development. Predicted in-stream concentrations were compared directly to the TMDL endpoints. Using the model linkage described in Section 4.5, total aluminum was simulated using the MDAS model and the DESC model was used to compare predicted dissolved aluminum concentrations to the TMDL endpoint. This comparison allowed evaluation of the expected magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods.

Figure 5-1 presents the annual rainfall totals for the years 1980 through 2001 at the Logan, WV weather station. The years from 1987-1992 are marked to indicate that a range of precipitation conditions was used for TMDL development in the Guyandotte watershed.

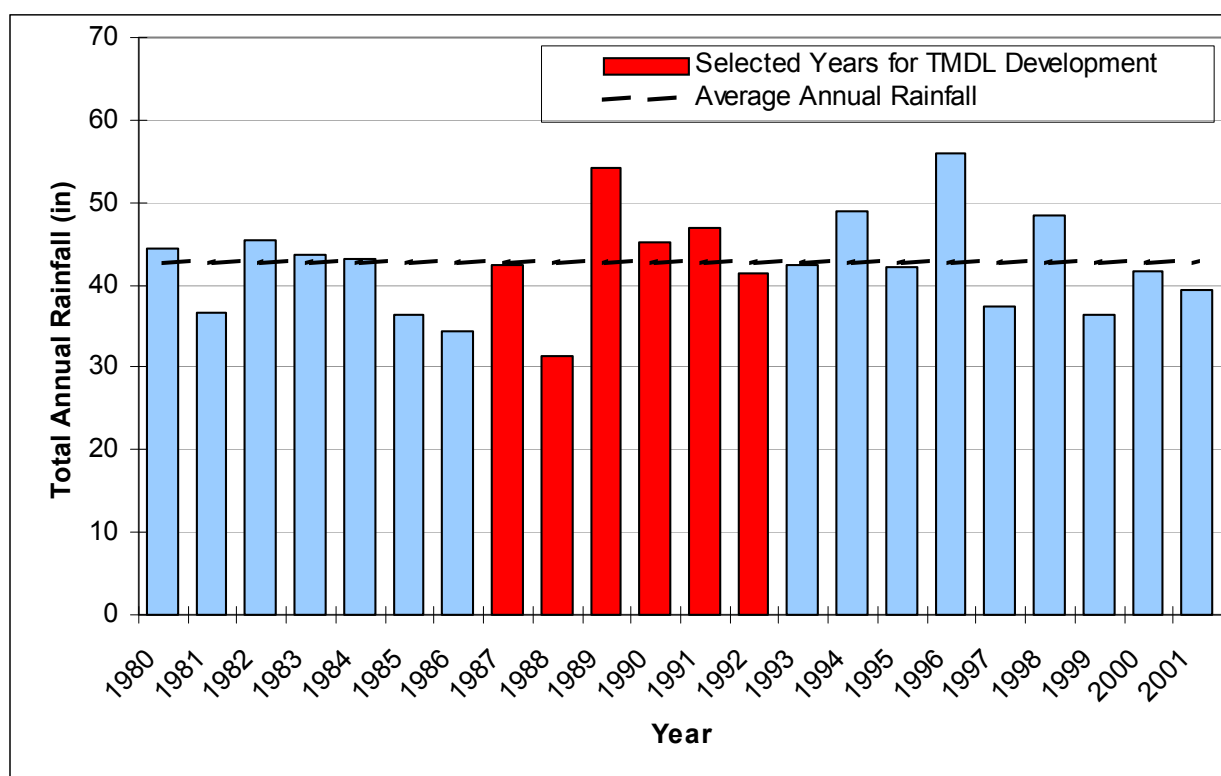


Figure 5-1. Annual Precipitation totals and Percentile Ranks for the Logan weather station

Permitted conditions for the mining facilities were represented using precipitation-driven flow estimations and the metals concentrations presented in Table 5-1.

Table 5-1. Metals concentrations used in representing permitted conditions for mines

Pollutant	Technology-based Permits	Water Quality-based Permits
Aluminum, total	3.27 mg/L (98 th percentile DMR values)	monitor only
Iron, total	3.2 mg/L	1.5 mg/L
Manganese, total	2.0 mg/L	1.0 mg/L

Permitted conditions for fecal coliform bacteria point sources were represented during baseline conditions using the design flow for each facility and the monthly average discharge of 200 counts/100mL.

5.3 Source Loading Alternatives

Simulation of baseline conditions provided the basis for evaluating each stream's response to variations in source contributions under virtually all conditions. This sensitivity analysis gave insight into the dominant sources and how potential decreases in loads would affect in-stream metals concentrations. For example, loading contributions from abandoned mines, permitted facilities, and other nonpoint sources were individually adjusted and in-stream concentrations were observed.

Multiple scenarios were run for the impaired waterbodies. Successful scenarios were those that achieved the TMDL endpoints under all conditions for dissolved aluminum, iron, manganese, and fecal coliform bacteria throughout the 6-year modeling period. For dissolved aluminum scenario development, the DESC was compared directly to TMDL endpoint. If predicted dissolved aluminum concentrations exceeded the TMDL endpoint, the total aluminum sources represented in MDAS were reduced. Exceedances for dissolved aluminum and iron were allowed once every three years. The averaging period associated with each water quality criterion was considered in these assessments. In general, loads contributed by sources that had the greatest impact on in-stream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, then subsequent reductions were made in point source (permitted) contributions.

An example of the concentrations for baseline and TMDL conditions for iron are presented in Figure 5-2.

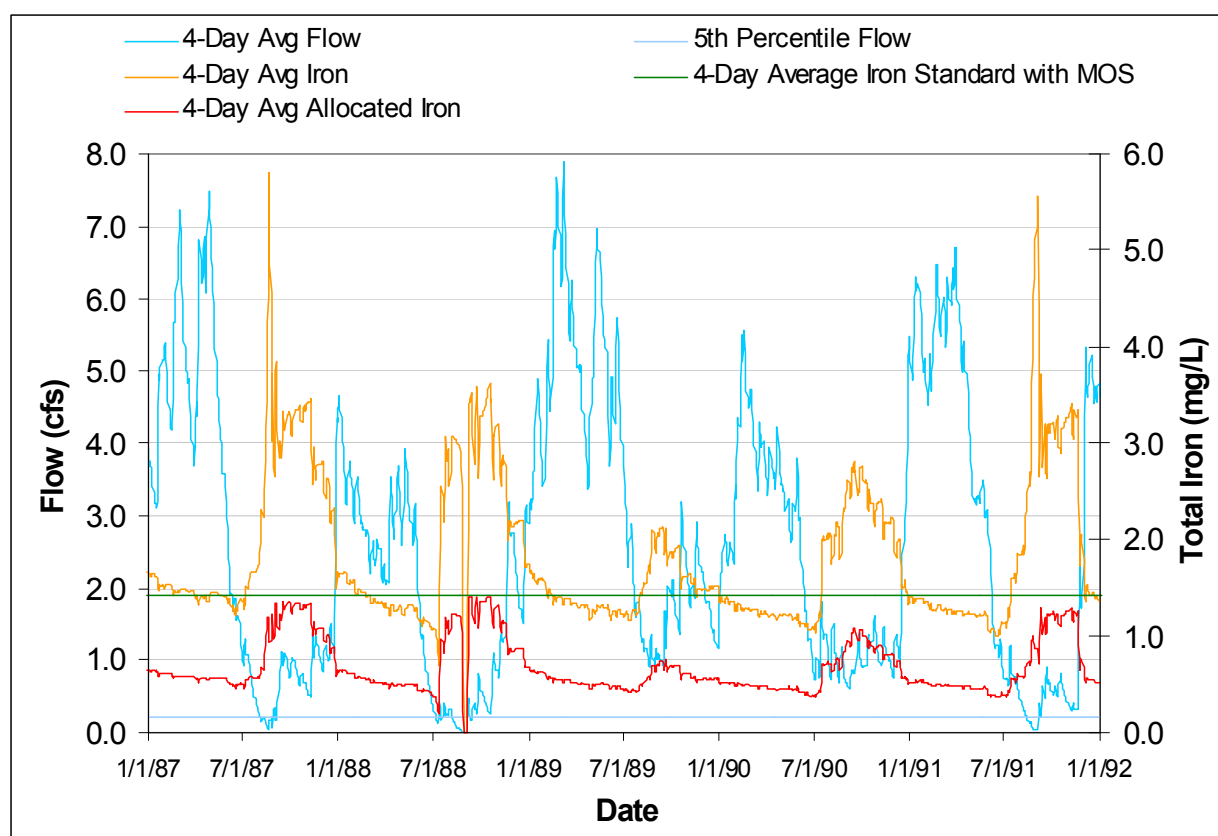


Figure 5-2. Baseline and TMDL conditions for iron

5.4 TMDLs and Source Allocations

5.4.1 Dissolved Aluminum, Total Iron and Total Manganese TMDLs

TMDLs and source allocations were developed for impaired segments of tributaries in the Guyandotte watershed. A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were first analyzed, because their impact frequently had a profound effect on down-stream water quality. Loading contributions were reduced from applicable sources for these waterbodies and TMDLs were developed. Source reductions never resulted in loading contributions less than natural conditions represented by the undisturbed forest (Table 5-2). Model results from the selected successful scenarios were then routed through down-stream waterbodies. Therefore, when TMDLs were developed for down-stream impaired waterbodies, up-stream contributions were representing existing or unreduced conditions from unimpaired streams and reduced conditions from impaired streams. Using this method, contributions from all sources were weighted equitably. In some situations, reductions in sources impacting unlisted headwaters were required in order to meet downstream water quality criteria. In other situations, reductions in sources impacting impaired headwaters ultimately led to improvements down-stream. This effectually decreased required loading reductions from potential down-stream sources.

The following general methodology was used when allocating to sources for the Guyandotte watershed TMDLs.

- For watersheds with AMLs but no permitted point sources, AMLs were reduced first, until in-stream water quality criteria were met or to conditions no less than those of undisturbed forest. If further reductions were required, then the sediment sources (Harvested Forest, Burned Forest, Oil and Gas operations, and Roads) were reduced until water quality criteria were met.
- For watersheds with AMLs and point sources, point sources were set at the precipitation induced load defined by the permit limits and AMLs were subsequently reduced. AMLs and revoked mining permits were reduced (point sources were not reduced) until in-stream water quality criteria were met, if possible. If further reduction was required once AMLs and revoked mines were reduced, sediment sources were then reduced. If even further reduction was required, the point source discharge limits were then reduced.
- For watersheds where dissolved aluminum TMDLs were developed, source allocations for total iron and manganese were developed first since their total in-stream concentrations (primarily iron) significantly reduce pH and consequently increase dissolved aluminum concentrations. If the dissolved aluminum TMDL endpoint was not attained after source reductions to iron and manganese, the total aluminum sources were reduced based on the methodology described above.

Table 5-2. Source Reduction (AML) for SWS 209

Parameter	Landuse	Total Area (acres)	Base Load (lb/yr)	Base Unit Area (lb/ac/yr)	Allocated Load (lb/yr)	Allocated Unit Area Loading (lb/ac/yr)
Aluminum	Undisturbed Forest	1000.00	390	0.39	390	0.39
Aluminum	AML	1000.00	224,989	224.99	9,000	9.00
Iron	Undisturbed Forest	1000.00	355	0.36	355	0.36
Iron	AML	1000.00	88,079	88.08	4,404	4.40
Manganese	Undisturbed Forest	1000.00	217	0.22	217	0.22
Manganese	AML	1000.00	391,081	391.08	7,822	7.82

Maximum Reductions: Fe: 95%; Al: 96%; Mn: 98%

The TMDLs for the Guyandotte watershed were determined on a subwatershed basis for each of the 14 defined regions.

Wasteload Allocations (WLAs)

Waste load allocations (WLAs) were made for all permitted mining operations except for limestone quarries and those with a Completely Released or Phase Two Released classification.

Loading from revoked permitted facilities was assumed to be a nonpoint source contribution based on the absence of a permittee.¹.

Based on the types of activities and the nature of their discharges, permitted non-mining sources (shown in Table 3-3) are believed to be negligible. Under this TMDL, these minor discharges are assumed to operate under their current permit limits. These facilities will be assigned WLAs that allow them to discharge at their current permit limits.

The WLAs for iron and manganese are presented in Tables 4a and 4b in Appendices A-1 through A-14, respectively. The WLAs for the dissolved aluminum TMDLs are presented in terms of total aluminum in Table 4c of Appendices A-7 - A-14. TMDLs were based on a dissolved aluminum TMDL endpoint, however sources were represented in terms of total aluminum, therefore dissolved aluminum TMDLs are presented in total terms. The WLAs are presented as annual loads, in terms of pounds per year and as constant concentrations. They are presented on an annual basis as an average annual load, because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Using the WLAs presented, permit limits can be derived using EPA's *Technical Support Document for Water Quality-based Toxics Control* (USEPA, 1991) to find the monthly average discharge concentration. The WLA concentration ranges are as follows: Al: 0.75-3.72 mg/L, Fe: 1.5 -3.2 mg/L, Mn: 1.0-2.0 mg/L.

Construction permits are modeled as background and are accounted for in Tables 5a, 5b, and 5c of Appendix A as "Other NPS." Therefore, the construction permits' limits are equivalent to existing limits and no reductions are required to achieve and maintain water quality standards.

Load Allocations (LAs)

Load allocations (LAs) were made for the dominant source categories, as follows:

- Abandoned mine lands - including abandoned mines (surface and deep) and high walls
- Revoked permits - loading from revoked permitted facilities
- Sediment sources - metals loading associated with sediment contributions from harvested forest, oil and gas well operations, and roads
- Other nonpoint sources - urban, agricultural, and forested land contributions (loadings from other nonpoint sources were not reduced)

The LAs for iron and manganese are presented in Tables 5a and 5b for each of Appendices A-1 through A-14. The LAs for the dissolved aluminum TMDLs are presented in terms of total aluminum in Table 5c of Appendices A-7 through A-14. TMDLs were based on a dissolved aluminum TMDL endpoint, however sources were represented in terms of total aluminum, therefore dissolved aluminum TMDLs are presented in total terms. The LAs are presented as annual loads, in terms of pounds per year. They are presented on an annual basis (as an average

¹The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are unpermitted point source discharges within these landuses. In addition, in establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Metals, Fecal Coliform and pH TMDLs for the Guyandotte River Watershed

annual load), because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Tables 5-3, 5-4, and 5-5 present the summation of the LAs and the summation of the WLAs for aluminum, iron, and manganese for each of the 303(d) listed segments.

Table 5-3. Load and waste load allocations for dissolved aluminum

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent Reduction
1	O-4	Guyandotte River	2,559,382	770,442	715,044	687,657	76,742	1,534,841	55
1	OG-51	Crawley Creek	4,348	4,348	0	0	229	4,577	0
11	OG-100	Clear Fork (OGC)	460,464	121,115	66,410	59,338	9,498	189,951	66
14	OG-134	Slab Fork	18,936	10,598	2,543	2,543	692	13,833	39
14	OG-138	Winding Gulf	160,013	31,576	14,270	14,270	2,413	48,259	74
5	OG-49	Big Creek	27,641	13,793	1,026	1,026	780	15,599	48
6	OG-65-B	Copperas Mine Fork	103,302	17,750	59,827	59,827	4,083	81,660	52
7	OG-89	Gilbert Creek	27,811	7,855	29,029	27,912	1,882	37,649	37
7	OG-96	Big Cub Creek	27,050	6,278	10,780	10,780	898	17,956	55
8	OG-75	Buffalo Creek	50,985	12,409	80,003	60,806	3,853	77,068	44

TMDLs were based on a dissolved aluminum TMDL endpoint, however sources were represented in terms of total aluminum, therefore dissolved aluminum TMDLs are presented in total terms.

Table 5-4. Load and waste load allocations for iron

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent Reduction
1	O-4	Guyandotte River	760,790	421,132	710,685	515,830	49,314	986,276	36
1	OG-10-A	Right Fork/Merritt Creek	272	272	0	0	14	286	0
1	OG-48	Limestone Branch	294	268	0	0	14	282	9
1	OG-51	Crawley Creek	3,261	2,962	0	0	156	3,118	9
1	OG-53	Godby Branch	56	56	0	0	3	59	0
1	OG-61	Buffalo Creek	3,149	847	0	0	45	892	73
1	OG-61-A	Right Fork/Buffalo Creek	64	64	0	0	3	68	0
10	OG-92-I	Muzzle Creek	1,750	1,343	0	0	71	1,414	23
10	OG-92-K	Buffalo Creek/Little Huff Creek	1,338	534	112	112	34	680	55
10	OG-92-K-1	Kezee Fork	65	65	0	0	3	69	0
10	OG-92-K-2	Mudlick Fork/Buffalo Creek	16	16	0	0	1	16	0
10	OG-92-Q	Pad Fork	4,310	1,497	506	506	105	2,109	58
10	OG-92-Q-1	Righthand Fork/Pad Fork	872	383	380	380	40	804	39
11	OG-100	Clear Fork (OGC)	96,785	44,298	66,783	58,120	5,390	107,808	37
11	OGC-12	Lower Road Branch	1,995	732	3,753	2,064	147	2,944	51
11	OGC-16	Laurel Fork	52,779	25,096	23,899	20,476	2,399	47,971	41
11	OGC-16-M	Milam Branch	2,076	1,706	0	0	90	1,796	18
11	OGC-16-P	Trough Fork	4,624	2,916	3,699	3,560	341	6,817	22
11	OGC-19	Toney Fork/Clear Fork	3,013	2,169	4,062	4,062	328	6,560	12
11	OGC-26	Crane Fork	8,033	1,678	2,779	2,779	235	4,692	59

Metals, Fecal Coliform and pH TMDLs for the Guyandotte River Watershed

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent Reduction
12	OG-110	Indian Creek	7,812	6,703	40,586	28,130	1,833	36,666	28
12	OG-110-A	Brier Creek/Indian Creek	394	394	153	153	29	575	0
12	OG-110-A-2	Marsh Fork/Brier Creek	70	70	109	109	9	189	0
13	OG-124	Pinnacle Creek	25,744	8,827	50,291	43,092	2,733	54,651	32
13	OG-124-D	Smith Branch/Pinnacle Creek	497	497	240	240	39	775	0
13	OG-124-H	Laurel Branch/Pinnacle Creek	55	55	809	606	35	696	23
13	OG-124-I	Spider Creek	285	285	34	34	17	336	0
14	OG-131	Barkers Creek	17,532	11,597	5,840	5,840	918	18,355	25
14	OG-131-B	Hickory Branch/Barkers Creek	351	351	0	0	18	370	0
14	OG-131-F	Gooney Otter Creek	8,785	3,341	4,559	4,559	416	8,316	41
14	OG-131-F-1	Jims Branch/Gooney Otter Creek	389	160	0	0	8	169	59
14	OG-131-F-2	Noesman Branch	1,301	530	573	573	58	1,161	41
14	OG-134	Slab Fork	10,630	8,317	2,489	2,489	569	11,374	18
14	OG-134-D	Measle Fork	124	124	0	0	7	130	0
14	OG-135-A	Left Fort/Allen Creek	2,652	564	0	0	30	594	79
14	OG-137	Devils Fork	4,519	4,519	0	0	238	4,757	0
14	OG-138	Winding Gulf	46,604	16,604	13,966	13,966	1,609	32,179	50
14	OG-139	Stonecoal Creek	14,328	5,279	3,460	3,460	460	9,199	51
5	OG-49	Big Creek	8,588	6,670	1,004	1,004	404	8,078	20
5	OG-49-A	Ed Stone Branch/Big Creek	73	73	0	0	4	77	0
5	OG-49-A-1	North Branch/ Ed Stone Branch	26	26	0	0	1	28	0
6	OG-65-A	Coal Branch/Island Creek	960	366	0	0	19	386	62
6	OG-65-B	Copperas Mine Fork	30,340	13,410	58,552	41,575	2,894	57,879	38
6	OG-65-B-1	Mud Fork	13,107	6,131	0	0	323	6,454	53
6	OG-65-B-1-A	Lower Dempsey Branch	1,434	516	0	0	27	544	64
6	OG-65-B-1-B	Ellis Branch/Mud Fork	2,049	829	0	0	44	872	60
6	OG-65-B-1-E	Upper Dempsey Branch	435	166	0	0	9	175	62
6	OG-65-B-4	Trace Fork/Copperas Mine Fork	6,679	1,030	13,877	8,326	492	9,848	54
7	OG-108	Little Cub Creek/Upper Guyandotte River	2,185	763	0	0	40	804	65
7	OG-127	Cabin Creek	861	861	331	331	63	1,255	0
7	OG-128	Joe Branch	2,787	483	791	791	67	1,341	64

Metals, Fecal Coliform and pH TMDLs for the Guyandotte River Watershed

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent Reduction
7	OG-129	Long Branch	1,539	317	1,606	1,606	101	2,024	39
7	OG-130	Still Run	4,711	1,820	1,136	1,136	156	3,111	49
7	OG-77-A.5	Oldhouse Branch/Rockhouse Creek	396	137	47	47	10	194	58
7	OG-89	Gilbert Creek	16,846	6,273	28,410	25,518	1,673	33,464	30
7	OG-96	Big Cub Creek	12,292	4,338	10,696	9,052	705	14,095	42
7	OG-96-A	Sturgeon Branch	34	34	0	0	2	36	0
7	OG-96-B	Road Branch	1,571	948	2,928	2,196	166	3,310	30
7	OG-96-C	Elk Trace Branch/Big Cub Creek	1,793	402	0	0	21	424	78
7	OG-96-F	Toler Hollow	305	145	443	310	24	480	39
7	OG-96-H	McDonald Fork	836	293	2,595	1,817	111	2,221	39
7	OG-99	Reedy Branch	2,153	2,153	4,211	2,948	268	5,369	20
8	OG-75	Buffalo Creek	27,377	10,812	78,297	48,677	3,131	62,620	44
8	OG-75-C.5	Proctor Hollow/Buffalo Creek	956	341	3,127	1,626	104	2,070	52
9	OG-76	Huff Creek	22,634	14,366	36,286	25,815	2,115	42,296	32
9	OG-76-L	Toney Fork/Huff Creek	3,319	1,068	6,083	3,954	264	5,286	47

Table 5-5. Load and waste load allocations for manganese

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent_Reduction
1	O-4	Guyandotte River	760,790	421,132	710,685	515,830	49,314	986,276	36
1	OG-10-A	Right Fork/Merritt Creek	272	272	0	0	14	286	0
1	OG-48	Limestone Branch	294	268	0	0	14	282	9
1	OG-51	Crawley Creek	3,261	2,962	0	0	156	3,118	9
1	OG-53	Godby Branch	56	56	0	0	3	59	0
1	OG-61	Buffalo Creek	3,149	847	0	0	45	892	73
1	OG-61-A	Right Fork/Buffalo Creek	64	64	0	0	3	68	0
10	OG-92-I	Muzzle Creek	1,750	1,343	0	0	71	1,414	23
10	OG-92-K	Buffalo Creek/Little Huff Creek	1,338	534	112	112	34	680	55
10	OG-92-K-1	Kezee Fork	65	65	0	0	3	69	0
10	OG-92-K-2	Mudlick Fork/Buffalo Creek	16	16	0	0	1	16	0
10	OG-92-Q	Pad Fork	4,310	1,497	506	506	105	2,109	58
10	OG-92-Q-1	Righthand Fork/Pad Fork	872	383	380	380	40	804	39
11	OG-100	Clear Fork (OGC)	96,785	44,298	66,783	58,120	5,390	107,808	37
11	OGC-12	Lower Road Branch	1,995	732	3,753	2,064	147	2,944	51
11	OGC-16	Laurel Fork	52,779	25,096	23,899	20,476	2,399	47,971	41
11	OGC-16-M	Milam Branch	2,076	1,706	0	0	90	1,796	18
11	OGC-16-P	Trough Fork	4,624	2,916	3,699	3,560	341	6,817	22

Metals, Fecal Coliform and pH TMDLs for the Guyandotte River Watershed

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent_ Reduction
11	OGC-19	Toney Fork/Clear Fork	3,013	2,169	4,062	4,062	328	6,560	12
11	OGC-26	Crane Fork	8,033	1,678	2,779	2,779	235	4,692	59
12	OG-110	Indian Creek	7,812	6,703	40,586	28,130	1,833	36,666	28
12	OG-110-A	Brier Creek/Indian Creek	394	394	153	153	29	575	0
12	OG-110-A-2	Marsh Fork/Brier Creek	70	70	109	109	9	189	0
13	OG-124	Pinnacle Creek	25,744	8,827	50,291	43,092	2,733	54,651	32
13	OG-124-D	Smith Branch/Pinnacle Creek	497	497	240	240	39	775	0
13	OG-124-H	Laurel Branch/Pinnacle Creek	55	55	809	606	35	696	23
13	OG-124-I	Spider Creek	285	285	34	34	17	336	0
14	OG-131	Barkers Creek	17,532	11,597	5,840	5,840	918	18,355	25
14	OG-131-B	Hickory Branch/Barkers Creek	351	351	0	0	18	370	0
14	OG-131-F	Gooney Otter Creek	8,785	3,341	4,559	4,559	416	8,316	41
14	OG-131-F-1	Jims Branch/Gooney Otter Creek	389	160	0	0	8	169	59
14	OG-131-F-2	Noesman Branch	1,301	530	573	573	58	1,161	41
14	OG-134	Slab Fork	10,630	8,317	2,489	2,489	569	11,374	18
14	OG-134-D	Measle Fork	124	124	0	0	7	130	0
14	OG-135-A	Left Fort/Allen Creek	2,652	564	0	0	30	594	79
14	OG-137	Devils Fork	4,519	4,519	0	0	238	4,757	0
14	OG-138	Winding Gulf	46,604	16,604	13,966	13,966	1,609	32,179	50
14	OG-139	Stoncoal Creek	14,328	5,279	3,460	3,460	460	9,199	51
5	OG-49	Big Creek	8,588	6,670	1,004	1,004	404	8,078	20
5	OG-49-A	Ed Stone Branch/Big Creek	73	73	0	0	4	77	0
5	OG-49-A-1	North Branch/ Ed Stone Branch	26	26	0	0	1	28	0
6	OG-65-A	Coal Branch/Island Creek	960	366	0	0	19	386	62
6	OG-65-B	Copperas Mine Fork	30,340	13,410	58,552	41,575	2,894	57,879	38
6	OG-65-B-1	Mud Fork	13,107	6,131	0	0	323	6,454	53
6	OG-65-B-1-A	Lower Dempsey Branch	1,434	516	0	0	27	544	64
6	OG-65-B-1-B	Ellis Branch/Mud Fork	2,049	829	0	0	44	872	60
6	OG-65-B-1-E	Upper Dempsey Branch	435	166	0	0	9	175	62
6	OG-65-B-4	Trace Fork/Copperas Mine Fork	6,679	1,030	13,877	8,326	492	9,848	54
7	OG-108	Little Cub Creek/Upper Guyandotte River	2,185	763	0	0	40	804	65

Metals, Fecal Coliform and pH TMDLs for the Guyandotte River Watershed

Region	DNR-Code	DNR-Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent_Reduction
7	OG-127	Cabin Creek	861	861	331	331	63	1,255	0
7	OG-128	Joe Branch	2,787	483	791	791	67	1,341	64
7	OG-129	Long Branch	1,539	317	1,606	1,606	101	2,024	39
7	OG-130	Still Run	4,711	1,820	1,136	1,136	156	3,111	49
7	OG-77-A.5	Oldhouse Branch/Rockhouse Creek	396	137	47	47	10	194	58
7	OG-89	Gilbert Creek	16,846	6,273	28,410	25,518	1,673	33,464	30
7	OG-96	Big Cub Creek	12,292	4,338	10,696	9,052	705	14,095	42
7	OG-96-A	Sturgeon Branch	34	34	0	0	2	36	0
7	OG-96-B	Road Branch	1,571	948	2,928	2,196	166	3,310	30
7	OG-96-C	Elk Trace Branch/Big Cub Creek	1,793	402	0	0	21	424	78
7	OG-96-F	Toler Hollow	305	145	443	310	24	480	39
7	OG-96-H	McDonald Fork	836	293	2,595	1,817	111	2,221	39
7	OG-99	Reedy Branch	2,153	2,153	4,211	2,948	268	5,369	20
8	OG-75	Buffalo Creek	27,377	10,812	78,297	48,677	3,131	62,620	44
8	OG-75-C.5	Proctor Hollow/Buffalo Creek	956	341	3,127	1,626	104	2,070	52
9	OG-76	Huff Creek	22,634	14,366	36,286	25,815	2,115	42,296	32
9	OG-76-L	Toney Fork/Huff Creek	3,319	1,068	6,083	3,954	264	5,286	47

5.4.2 Fecal Coliform Bacteria TMDLs

A top-down methodology was followed to develop the Fecal Coliform TMDL for the Guyandotte River mainstem and allocate loads to sources. Since the modeling effort was developed on a large scale to address the fecal coliform bacteria impairment in the Guyandotte mainstem, source contributions from the upstream tributaries in the Guyandotte River watershed were reduced to meet the TMDL endpoint in the Guyandotte River mainstem only. Loading contributions from each tributary were reduced and assigned a gross load allocation. Headwaters tributaries were reduced first because their impact frequently had a profound effect on downstream water quality in the Guyandotte mainstem. Headwater tributary loads were incorporated into gross load allocations for tributaries to the Guyandotte River mainstem.

The following general methodology was used when allocating to sources for the Guyandotte River fecal coliform bacteria TMDL:

- All point sources in the Guyandotte watershed were set at permit limits (200 counts/100mL monthly average) and all illicit, non-disinfected discharges of human waste (i.e., straight pipes and failing septic systems) as well as any Sanitary Sewer Overflows (SSOs) and CSOs were eliminated. If further reduction was necessary, source loadings from residential areas and agricultural lands were subsequently reduced until in-stream water quality criteria were met.
- Tributaries to the Guyandotte River mainstem are not known to be impaired for fecal coliform bacteria. Future monitoring in the Guyandotte River watershed may reveal fecal

coliform impairments which would then be listed on the Section 303(d) list of impaired waters. Subsequent TMDL development would follow West Virginia's Watershed Management Framework process.

Wasteload Allocations (WLAs)

Waste load allocations (WLAs) were made for all facilities permitted to discharge fecal coliform bacteria directly to the Guyandotte mainstem. This TMDL analysis assumed that all permittees exceeding their permit limits will be notified and the exceedances will be stopped before implementation of this TMDL. Therefore, all permitted fecal coliform sources are represented by the monthly average fecal coliform limit of 200 counts/100mL and no reductions were applied.

Municipal Separate Storm Sewer System (MS4s)

EPA's stormwater permitting regulations require municipalities to obtain permit coverage for all storm water discharges from separate storm sewer systems (MS4s). There are two designated MS4 municipalities along the Guyandotte River mainstem: the City of Huntington and Town of Barboursville. Because these municipalities have filed a Notice of Intent for MS4 permit issuance, and for lack of clearly defined Municipal Separate Storm Sewer System (MS4s) drainage areas, the area within the corporate limits watershed is therefore assumed to be subject to MS4 storm water permits. The source loading associated with stormwater runoff from the urban and residential landuses within corporate limits of each municipality were included in the waste load allocations. The Town of Milton is a designated MS4 municipality in the Guyandotte watershed that discharges to the Mud River mainstem. The fecal coliform bacteria TMDL was developed for the Guyandotte mainstem only and headwater tributary loads were incorporated into gross load allocations for tributaries to the Guyandotte River mainstem. Therefore, loading associated with the Milton MS4 was included in the gross load allocation for the Mud River (see Table 6 in Appendix A-2). Stormwater permits and their relationship to TMDLs are discussed further in Appendix G.

The fecal coliform bacteria WLAs are presented as annual loads, in terms of counts per year. They are presented on an annual basis (as an average annual load), because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Table 5-6 presents the individual WLAs for the Guyandotte River watershed.

Table 5-6. Individual fecal coliform MS4 WLAs for the Guyandotte River watershed

Town	Parameter	Baseline Load	Reduced Load	% Reduction
Barboursville	Fecal coliform	1.61721E+13	4.29734E+12	73
Huntington	Fecal coliform	7.84365E+13	2.35309E+13	73

Load Allocations (LAs)

The endpoint for fecal coliform bacteria was selected as the instantaneous endpoint of 380 counts/100mL based on the 400 counts/100mL criterion for human health minus an approximate 5 percent MOS and the geometric mean endpoint of 190 counts/100mL based on the 200 counts/100mL geometric mean criterion minus an approximate 5 percent MOS.

Table 5-7 presents the summation of the LAs and WLAs for fecal coliform bacteria for the Guyandotte river mainstem. LAs and WLAs for tributaries to the Guyandotte River are presented in Table 6 of Appendixes A-1 through A-14.

Table 5-7. Load and waste load allocations for fecal coliform bacteria for the Guyandotte River mainstem

Outlet	DNR Code	DNR Name	Baseline LA	LA	Baseline WLA	WLA	MOS	TMDL	Percent Reduction
1000	O-4	Guyandotte River	1.28e+16	1.30e+15	214819668659	214819668659	6.87e+13	1.37e+15	89.81

5.4.3 Selenium TMDLs

The following general methodology was used when allocating to sources for the selenium TMDLs in the upper Mud River Watershed

- Nonpoint sources in the watershed did not appear to be contributing excessive loads of selenium to the watershed and, therefore, are not required to reduce loadings.
- The WLAs were determined by setting the allocation at the water quality criteria for selenium

The selenium TMDLs for the upper Mud River watershed are presented in Table 5-8.

Table 5-8. Selenium TMDLs for the Mud River watershed

DNR Code	Stream Name	TMDL (ug/L)	MOS	WLA (ug/L)	LA(ug/L)
WVOG-2	Mud River upstream of Upton Fork	5.0	Implicit	5.0	NA
WVOGM-47	Sugar Tree Branch	5.0	Implicit	5.0	NA
WVOGM-48	Stanley Fork	5.0	Implicit	5.0	NA

Wasteload Allocation

WLAs were assigned to the surface mining point sources in the upper Mud watershed. The WLAs are presented as concentrations, in terms of micrograms per liter at a 7Q10 flow of 0 cfs. The WLA for each point source is 5 ug/L for selenium based on the assumption that a discharge concentration meeting the water quality criteria will result in meeting the water quality criteria in the impaired streams as well.

Load Allocation

Since a 7Q10 flow of 0 cfs would result in an absence of flow from nonpoint sources because of their dependence on rainfall and runoff processes, the LA is equivalent to 0 ug/L for selenium.

5.4.4 pH Modeling Results

As described in Section 4.5.2, the MINTEQA2 model was run for each of the pH impaired streams in the Guyandotte watershed to simulate various scenarios. Input values for Fe and Mn were based on TMDL endpoints (maximum allowable limits) and the maximum observed

concentrations for the specific pH impaired stream were used as the total aluminum inputs (refer to Section 4.5.2 for details). The resultant equilibrium pH for each of the pH impaired streams are presented in Table 4-10.

5.4.5 Seasonal Variation

TMDL must consider seasonal variation in the derivation of the allocation. For the Guyandotte River watershed metals TMDLs, seasonal variation was considered in the formulation of the modeling analysis. By using continuous simulation (modeling over a period of several years), seasonal hydrologic and source loading variability was inherently considered. The metals concentrations simulated on a daily time step by the model were compared to TMDL endpoints. An allocation which meets these endpoints throughout the year was developed.

5.4.6 Critical Conditions

TMDL developers must select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a "critical condition." The critical condition is the set of environmental conditions which, if controls are designed to protect, will ensure attainment of objectives for all other conditions.

Nonpoint source loading is typically precipitation-driven. In-stream impacts tend to occur during wet weather and storm events that cause surface runoff to carry pollutants to waterbodies. During dry periods, little or no land-based runoff occurs, and elevated in-stream bacteria levels may be due to point sources (Novotny and Olem, 1994). Water quality data analysis in the Guyandotte watershed shows high aluminum, iron, manganese, and fecal coliform bacteria concentrations during both high and low flow, indicating that there is both a point and nonpoint source issue. Both high-flow and low-flow periods were taken into account during TMDL development by using a long period of weather data that represented wet, dry and average flow periods (see Section 5.2). As stated previously, the critical condition for high selenium concentrations occurs at a low flow 7Q10 condition of 0 cfs and the nonpoint source contributions of selenium were considered to be negligible. Therefore, the TMDLs were based on wasteload allocations assigned at water quality criteria for selenium at the end of pipe.

5.4.7 Future Growth

This Guyandotte TMDL does not include specific future growth allocations to each subwatershed. However, the absence of specific future growth allocations does not prohibit new mining in the subwatersheds for which load allocations and/or wasteload allocations have been established pursuant to this TMDL. Pursuant to 40 CFR 122.44 (d)(1)(vii)(B), effluent limits must be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge...." In addition, federal regulations generally prohibit issuance of a permit to a new discharger "if the discharge from its construction or operation will cause or contribute to the violation of water quality standards." 40 CFR 122.4(i). A discharge permit for a new discharger could be issued in the subwatersheds for which this TMDL establishes load and/or wasteload allocations under the following scenarios:

1. A new facility could be permitted anywhere in the watershed, provided that effluent limitations are based upon the achievement of water quality standards end-of-pipe for the pollutants of concern in the TMDL.

2. Remining could occur without a specific allocation to the new permittee, provided that the requirements of existing State remining regulations are achieved. Remining activities are viewed as a partial nonpoint source load reduction from Abandoned Mine Lands.
3. Reclamation and release of existing permits could provide an opportunity for future growth provided that permit release is conditioned upon achieving discharge quality better than the wasteload allocation prescribed by the TMDL.

West Virginia may revise the TMDL, with approval from EPA, to reallocate the distribution of loads to accommodate future growth. It is also possible that the TMDL might be refined in the future through remodeling. Such refinement might incorporate new information and/or redistribute pollutant loads. Trading might provide an additional opportunity for future growth, contingent on the state's development of a statewide or watershed-based trading program.

5.4.8 Water Quality Trading

This TMDL neither prohibits nor authorizes trading in the Guyandotte River watershed. Both the WVDEP and EPA generally endorse the concept of trading and recognize that it might become an effective tool for TMDL implementation. However, significant regulatory framework development is necessary before large-scale trading in West Virginia may be realized. EPA will cooperate with WVDEP in its development of a statewide or watershed-based trading program. Further, EPA supports program development assisted by a consensus-based stakeholder process.

Before the development of a formal trading program, it is conceivable that the regulation of specific point source-to-point source trades might be feasible under the framework of the NPDES program. EPA commits to cooperate with the WVDEP to facilitate such trades if opportunities arise and are proven to be environmentally beneficial.